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## Avocado diseases

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In New South Wales avocados are grown in the coastal areas north of Gosford with some plantings in the irrigation areas along the lower Murray River. The principal soils are basaltic clay loams on the coast and deep sands at Stuarts Point and on the Murray.

The main cultivar is Hass. It is grafted on seedling rootstocks derived from non-edible avocados of the

Mexican or Guatemalan botanical races. Fuerte and Sharwil, once popular varieties, are now on the decline. Lamb Hass, a new variety, is being planted in some areas. Fruit are harvested from April to December.

Avocados must be regarded as a high risk investment, because of tree deaths from disease and fruit losses, both in the field and post-harvest.

**Trees chronically affected by Phytophthora root rot lose leaves at the ends of branches and are liable to sunburn on stems and fruit.**





**Top: Phytophthora root rot affects feeder roots of avocado seedlings in the nursery, without causing obvious symptoms in the shoots. Look for healthy white roots on plants you buy. Lower: bleeding stem canker caused by Phytophthora. The white exudate is dried sugar crystals.-Photos: K. Pegg, Queensland Department of Primary Industries.**

## **DISEASES CAUSED BY PARASITES PHYTOPHTHORA ROOT ROT**

**Importance:** A percentage of avocado trees die each year from root rot. The number is largely dependent on the amount and intensity of rainfall. Orchards may be killed out after one season of heavy rainfall. Trees commonly die as they begin to bear fruit, well before any profit is made.

**Cause:** The soil fungus *Phytophthora cinnamomi*.

**Host range:** Over 800 plant species are hosts of the avocado root rot pathogen.

**Symptoms:** Young feeder roots become black and brittle and die. In advanced stages, only remnants of the root system remain. Phytophthora infection can also develop as trunk cankers which appear as water-soaked, dark brown areas at or below ground level. A white secretion of sap is often present within cankers but can also result from other causes. Laboratory diagnosis may be needed to confirm the causal agent. If the trunk is completely girdled by cankers, rapid death occurs. Loss of feeder roots affects uptake of water and nutrients, which in turn affects the health of the canopy. Initially there is a heavy flowering and fruit set, but fruit remain small. Later, leaves curl, droop and slowly become yellow. Leaf margins and veins become brown because roots are unable to control salt uptake.

Fruit shrivel on the tree and a scabby lesion may develop on the stem as a result of water stress, even though soil moisture is adequate. Fruit with stalks affected by these ring-neck lesions commonly fall as they mature.

The soil beneath affected trees remains wet long after rain, because the tree is unable to absorb the moisture.

**Occurrence and spread:** The pathogen occurs in most regions of Australia and in many other areas of the world, but may not be present or active on a property until introduced on infected nursery plants of one of its hosts. It can also be introduced in contaminated soil, tools, footwear, vehicles, muddy storm water or infected seed taken from fruit in contact with soil.

**Control:** There is no simple answer to Phytophthora root rot in avocados, but good horticultural management can minimise losses.

*Site selection.* Pick a site with excellent drainage. The soil should be at least 2 m deep and water should be able to flow through it during the heaviest expected rainfall (for example, 250 mm per day on the coast). Air should be able to enter immediately rain ceases.



## CHECKLIST FOR EXCLUDING PHYTOPHTHORA FROM NURSERIES

- Seed taken from fruit harvested directly off tree.
- Potting mix allows air into 15% of pore space after watering.
- Potting mix disinfested with aerated steam.
- Pathogen free potting mix.
- Pathogen free water.
- Wire-mesh bench tops, at least 30 cm off floor.
- Visitors and stray animals restricted entry.
- Copper footbaths at all entrances.
- Root systems examined and regularly tested for disease.
- A contingency plan prepared for disinfesting nursery when disease outbreaks occur.

Test the soil by digging observation holes with an auger or back-hoe. Water should drain away within an hour or so of rain or after filling the hole with water.

*Land preparation.* Start at least one year before planting trees. Break clay pans with a ripper. Construct storm water diversion drains above and throughout the planting and mound rows on which trees are to be planted. Plan tree rows to run down-slope so that storm water is shed quickly.

Take a soil sample for chemical analysis and apply fertilisers based on this test.

Grow cover crops such as cowpea, soybean, clover, lupin, sorghum, maize or banana. Properly fertilised these cover crops increase humic materials and the nutrient holding capacity of the soil.

Establish temporary windbreaks of bana grass and consider permanent windbreaks particularly on windy sites. Tree selection is important. Select species adapted by your locality. They should be fast growing, able to withstand winds and be drought tolerant.

The design of your irrigation system should be done by a qualified irrigation specialist who has expertise in horticultural irrigation technology.

*Planting* Buy grafted trees from an accredited ANVAS (Avocado Nursery Voluntary Accreditation Scheme) nursery. They practise methods to exclude soil-borne plant pathogens from their trees.

Enquire as to the source of rootstock seed used. Velvick and Duke 7 appear to have some tolerance to phytophthora root rot. However, Duke 7 appear to be more susceptible to anthracnose disease. Reed produces a uniform tree. West India rootstocks are being trialled to assess their tolerance to salinity in irrigation areas.

Select small trees in large containers that have active root systems rather than larger trees that have become root-bound. Nursery trees may be treated with an appropriate registered fungicide prior to delivery.

Plant nursery trees promptly following their arrival. When trees need to be held hold them off the ground away from soil. Do not apply fertiliser to the planting hole, as this can burn young roots or inhibit root extension into surrounding soil.

If nursery trees have not been treated with fungicide before delivery, apply a fungicide (refer to label instructions) on the soil surface around each tree.

Cover the soil surface with 5 cm depth of hay or stubble from sorghum, soybean or lucerne. Cover an area about one metre radius around the young tree.

*Care of young trees.* Irrigate frequently to avoid moisture stress, but do not saturate the soil. Monitor the level of soil moisture with tensiometers placed at various depths throughout the block.

Apply fertilizers to young trees in small amounts, but often. For example in year 1 apply four applications of 15g urea, 50g superphosphate and 10g sulphate of potash per tree, and in year 2 apply four applications of 25g urea, 50g superphosphate and 20g sulphate of potash per tree. Spread evenly extending beyond the canopy area. Organic fertilisers are beneficial and can be used with the above program. Apply up to 10L of poultry manure per tree.

### **Care of established trees.**

Take soil and leaf samples annually in autumn for chemical analysis. Aim at a soil acidity of pH 5.5 by the adequate use of lime or dolomite, and maintain soil phosphate, sulphate, calcium and boron, but relatively low nitrate and chloride.

Once trees commence bearing a fertiliser program based on nutrient crop replacement should be followed. This is a sustainable strategy to avoid under or over fertilization. Irrigation timings and amounts should be based on crop transpiration figures.

Cover cropping becomes more difficult as trees age and canopies increase in size, but an effective mulch is provided by falling leaves. Additional mulch in the

form of hay may be imported.

Preventative measures for control of root rot in healthy trees include the regular application of fungicides. A range of products is available including foliar fungicides, fungicide granules for soil application and stem injection formulations. Applications should begin with the spring growth flush and need to be repeated through the summer to autumn period.

Trees with drooping or slightly yellow foliage can be given curative fungicide treatments. However, if the trees do not respond after six months, treatment should be discontinued. Fungicide treatment alone is unlikely to restore trees to full productivity.

Where trunk cankers are present they can be cut out and treated with registered fungicides. Mulch should be kept away from the base of the tree and sprinklers positioned to minimise water splash against the trunk. Avoid injuring trunks with machinery.

When fungicides are used, the label directions must be strictly followed to ensure maximum benefits and avoid any unwanted side effects.

*Replanting strategy.* Long-term production of avocados depends on regular planting of new areas to compensate for losses from root rot and to replace trees that have become too large to spray and harvest economically.

Except when trees are small, little is gained by replanting trees in established orchards. Areas where trees die from root rot may be considered not safe for replanting avocados. However, if clean land is unavailable use old avocado land and prepare it as for a new orchard. Cover cropping is particularly important prior to planting to allow old avocado roots to rot and major concentrations of the pathogen to die out.

## SUNBLOTCH

**Cause:** Avocado sunblotch viroid.

**Spread by:** Infected seed, grafting wood, pruning and cutting implements, natural root grafting between trees and pollinating insects.

**Host range:** Avocado, cinnamon, camphor laurel.

**Symptoms:** Streaking and spotting of the bark and fruit, often depressed, usually yellow but ranging from white to red. Occasionally leaves may have white or yellow mottles, similar to variegation. Fruit may be small and misshapen, their number varying from none to many per infected tree. Many infected trees never show symptoms but produce seed which, when used for rootstocks, infect the scion variety and cause



**Top: Yellow streaks on stems are typical symptoms of sunblotch. Lower: sunken, irregular sunblotch on Fuerte fruit.-Photo: J. Dale, Queensland Department of Primary Industries.**

severe disease symptoms. Vigorous water-shoots often grow from buds below the affected scion but rarely produce fruit.

**Incidence:** Sunblotch has been recorded only at Alstonville on the north coast of New South Wales and on some farms in the lower Murray.

Infected trees have been destroyed upon discovery and generally the incidence is considered very low, as is the case in other States of Australia. But there may still be some unidentified, symptomless infected trees from which seed may be taken.

**Control:** This depends on the use of seed and budwood from propagation sources certified free of sunblotch. There is no absolute test for freedom from sunblotch infection but a biochemical test is used to eliminate trees that may be symptomless carriers of the disease.

## ANTHRACNOSE

**Cause:** The fungus *Colletotrichum gloeosporioides*.

**Host range:** Most tropical fruits.

**Symptoms:** The fungus infects young stems, leaves, flowers and fruit but infection does not develop fully until the tissue is injured or begins to ripen. Infected tissue then rapidly decays.

Leaf spots are brown to black and angular. The dead centre often falls out, leaving a shothole effect. Flowers are rarely diseased. Damage to the stem, including grafted scion pieces, begins as a brown rot of the bark near injuries and then extends rapidly back to a point where plant sap is still mobile. On fruit there may be numerous brown or black spots which appear dormant. One or more of these become active and enlarge rapidly in the skin and underlying flesh. Within a few days the fruit falls from the tree. Dormant anthracnose spots become active after the fruit is harvested and render it inedible before it is fully ripe.

**Spread by:** Spores are produced on infected dead tissue. Pink or orange spore masses develop when the tissue has been wet for several hours and are then washed off by rain. Seed and scionwood used for propagation also carry the pathogen.

**Favoured by:** Surface moisture (dew, rain) that persists for ten or more hours, and air temperatures above 15°C. Closely planted trees with dense canopies inhibit air movement and encourage infection. Fruit harvested early or late in the season, when temperatures are high, are prone to severe anthracnose

**Inactive black anthracnose spots on Fuerte fruit—  
Photo: R. Fitzell.**



post-harvest.

**Control:** Ensure good ventilation and rapid drying of the foliage by pruning lower limbs so that the canopy is at least 50 cm above ground level.

At monthly intervals from October (after flowering) until May, spray with a registered fungicide. Ensure that fruit are fully covered with spray.

Harvest fruit when it is fully mature so that it will ripen quickly and evenly. Keep harvested fruit out of direct sunlight to prevent the flesh overheating. Before packing, treat fruit with a registered curative fungicide.

Following packing cool store hard green avocados at 4 to 5°C (Hass) and 6 to 8°C (other varieties) Ideally transport temperatures should be 7 to 10°C.

## VERTICILLIUM WILT

**Cause:** The soil fungus *Verticillium dahliae*.

**Host range:** The wide range of host plants includes common weeds such as thistle and lantana and vegetables such as tomato and potato. Most legumes and grasses recommended as cover crops are non-hosts.

**Symptoms:** The leaves on one branch (rarely the whole tree) suddenly wilt and hang for many weeks. When the bark is peeled away the underlying tissue (cambium) is brown.

Symptoms commonly develop in August or September. Fresh growth from below the affected branch is usually healthy and the tree may eventually recover to full productivity.

**Spread by:** Spores of the fungus that persist in the soil and on alternative host plants. The spores are also carried on grafting wood taken from affected branches, but such wood rarely survives in the nursery.

**Favoured by:** Previous cropping or inter-cropping with susceptible host plants. Old tomato and potato land is the most common source of the problem.

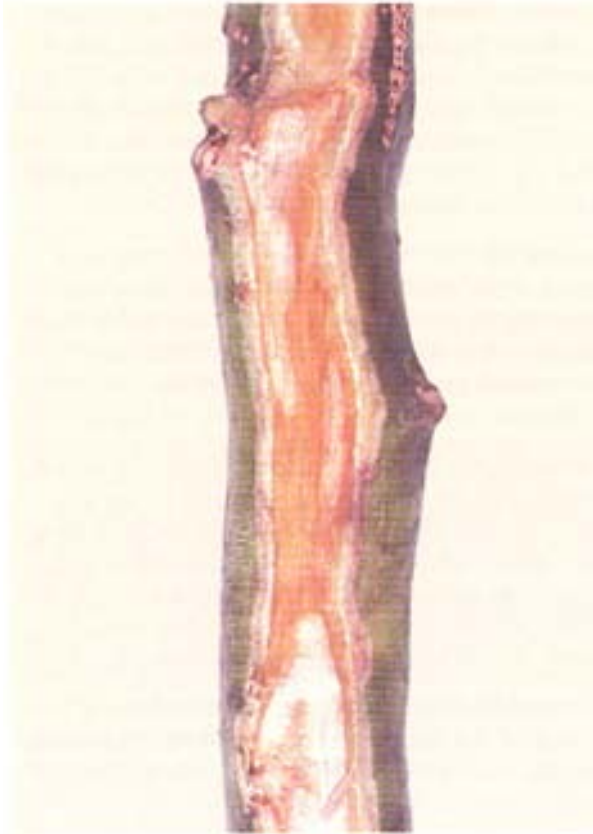
**Control:** Avoid land where highly susceptible crops have been grown. Diseased trees seldom need any treatment except the removal of dead limbs. When selecting grafting wood, avoid trees that have displayed symptoms of the disease.

## SOFT ROT OF FRUIT

**Cause:** The bacterium *Erwinia sp.*, in association with anthracnose.

**Symptoms:** May occur in the field and post-harvest. Externally the fruit has a darkened metallic sheen. Internally, the flesh is brown, softened, sometimes





**Verticillium wilt symptoms under bark.**-Photo: K. Pegg, Queensland Department of Primary Industries.

even liquid, and there is a rancid (butyric) smell.

**Favoured by:** Cool wet weather as the fruit near maturity; harvesting fruit on rainy days. The varieties Fuerte and Sharwil appear more susceptible than Hass.

**Control:** Maintain fungicide program as for anthracnose. Prevent surface scratches at harvest. Clip the fruit from the tree and leave the fruit stalks on during packing. Avoid picking fruit on rainy days or washing them in dip tanks before packing.

#### **STEM-END ROT**

**Cause:** Several fungi including *Dothiorella* spp., *Phomopsis perseae* and *Lasioidiplodia theobromae*.

**Host range:** Some of the causal fungi infect other hosts.

**Symptoms:** Only develop after harvest. The earliest sign of infection is a slight shrivelling of the stem-end with fungal growth sometimes evident on the abscission scar. Subsequently, rot develops from the stem-end of the fruit. Externally the affected tissue darkens and the area of rot has a well defined and advancing margin. Internally, the flesh is discoloured brown and the vascular bundles may discolour in advance of the rotting flesh.

**Spread by:** The causal fungi are present on dead tissue within the tree canopy and are also present on fallen leaves and stems. Spores are released from these sources during wet weather and initiate infections in stem-end tissue and maturing fruit. The infections are normally quiescent or symptomless until after harvest when chemical changes in the maturing fruit allow the fungi to become active and cause rotting after harvest.

**Favoured by:** Wet seasons are more favourable for development of inoculum within the tree canopy and usually result in higher incidences of post-harvest stem-end rot.

**Control:** Maintain healthy canopies to reduce the build up of inoculum on dead tissue. Mulching will enhance the breakdown of fallen leaves and reduce the release of inoculum from this source. Maintain even soil moisture and control root rot as water stress can predispose fruit to infection. Fungicides applied for control of anthracnose will help to control stem-end rot by reducing air-borne inoculum. Post-harvest treatment with a registered fungicide is necessary in most seasons. Avoid injury to fruit as far as possible and store and ripen at appropriate temperatures during the harvest to retail market period to ensure maximum quality.

#### **SOOTY BLOTCH**

**Cause:** A number of fungi.

**Host range:** The fungi responsible affect a wide range of hosts.

**Symptoms:** Dark, superficial fungal growth develops on the surface of fruit, leaves and lateral branches. The underlying tissue is not damaged but affected fruit may be unsuitable for market.

**Spread by:** Air-borne spores.

**Favoured by:** Surface moisture (dew, rain), dense canopies and warm temperatures.

**Control:** The fungicides that are applied for control of anthracnose also control sooty blotch. Sooty blotch is normally only present where fungicides have not been applied or application schedules are defective.

#### **NON-PARASITIC DISORDERS**

In some situations the appearance of symptoms on avocado trees can be caused by factors such as nutritional deficiencies or toxicities and environmental stress. Where nutritional factors are suspected it is recommended that the nutritional status of the soil and plant tissue is determined by analysis of appropriate samples in an accredited laboratory.

## ASPHYXIATION

**Cause:** Deficiency of oxygen in the soil around the feeder roots.

**Symptoms:** The feeder roots become translucent from accumulated products of fermentation (alcohol). Leaves on the canopy wilt, though often remain a bronze-green colour, and hang for a week or more.

**Favoured by:** Heavy rainfall on soils with impeded drainage, or heavy irrigation. Stagnant water in the soil loses oxygen rapidly when temperatures are high, so within a few hours the roots are unable to absorb water and the tree wilts.

**Control:** See site selection as for *Phytophthora* root rot. Prune affected limbs as soon as symptoms develop to prevent uncontrolled loss of water from the stems, but take care to prevent sunburn by coating the stems with white acrylic paint.

## ALBINISM

**Cause:** Planting immature seed.

**Symptoms:** The first leaves on the avocado seedling are white and distorted. Eventually a healthy shoot grows from the stem, by which time the plant is too old to be used for a rootstock.

**Control:** Harvest seed when the fruit are fully mature. Cull out affected plants in the nursery.

## SECTORAL CHIMERA

**Cause:** Bud mutation leading to lack of chlorophyll.

**Symptoms:** These may appear as variegations on leaves and shoots but most commonly appear as continuous stripes on fruit, extending from end to end. Unlike sunblotch, chimera tissue is not sunken or distorted.

**Control:** Prune out and avoid taking grafting wood from affected branches.

## RING NECK

**Cause:** Unknown.

**Symptoms:** The stalk of immature fruit develops a brown to black spot, similar to anthracnose, which girdles the bark without affecting the water-conducting tissue. The bark dries out and falls away. The fungus *Cladosporium* commonly occurs in the dead tissue.

Sometimes the stalk withers and fruit fall prematurely. Other times, the stalk is girdled and breaks. All cultivars are affected, but Hass is affected more than most.

**Favoured by:** Moisture stress in the plant associated with root rot or irregular irrigation.



**Sectoral chimeras extend lengthwise from one end of the fruit to the other.**

**Control:** Harvest when fruit are mature but before they fall. Maintain fungicide spray program for root rot.

## FURTHER INFORMATION

Enquiries from commercial growers about diseases of avocado and specimens for disease identification should be submitted initially to the nearest District Horticulturist.

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### DISCLAIMER

The information contained in this publication is based on knowledge and understanding at the time of review June 2004. However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of New South Wales Department of Agriculture or the user's independent adviser.